Competing for the World's Largest Infrastructure Project: Over 100 Million Jobs at Stake

business trends, future scenario, historical perspective, new strategy, people making a difference, powerful idea, prediction, social trends, technology trends

October 30th, 2013

Elon Musk and Daryl Oster, competing for what could become the world's largest infrastructure project

When Tesla Motors CEO, Elon Musk, mysteriously leaked that he was working on his Hyperloop Project, the combination of secrecy, cryptic details, and his own flair for the dramatic all contributed to the media frenzy that followed.

Leading up to this announcement was his growing anxiety over California's effort to build a very expensive high-speed rail line between Los Angeles and San Francisco with outdated technology.

While the Musk media train was picking up steam, several reporters pointed out a similar effort by Daryl Oster and his Longmont, Colorado-based company, ET3, to build a comparable tube transportation system that was much further along.

Indeed both are working on what will likely be the next generation of transportation where specially designed cars are placed into sealed tubes and shot, much like rockets, to their destination. While high-speed trains are breaking the 300 mph speed barrier, tube transportation has the potential to make speeds of 4,000 mph a common everyday occurrence.

As Daryl Oster likes to call it, "space travel on earth."

Even though tube travel like this will beat every other form of transportation in terms of speed, power consumption, pollution, and safety, the big missing element is its infrastructure, a tube network envisioned to combine well over 100,000 miles of connected links.

While many look at this and see the lack of infrastructure as a huge obstacle, at this point in time it is just the opposite, the biggest opportunity ever.

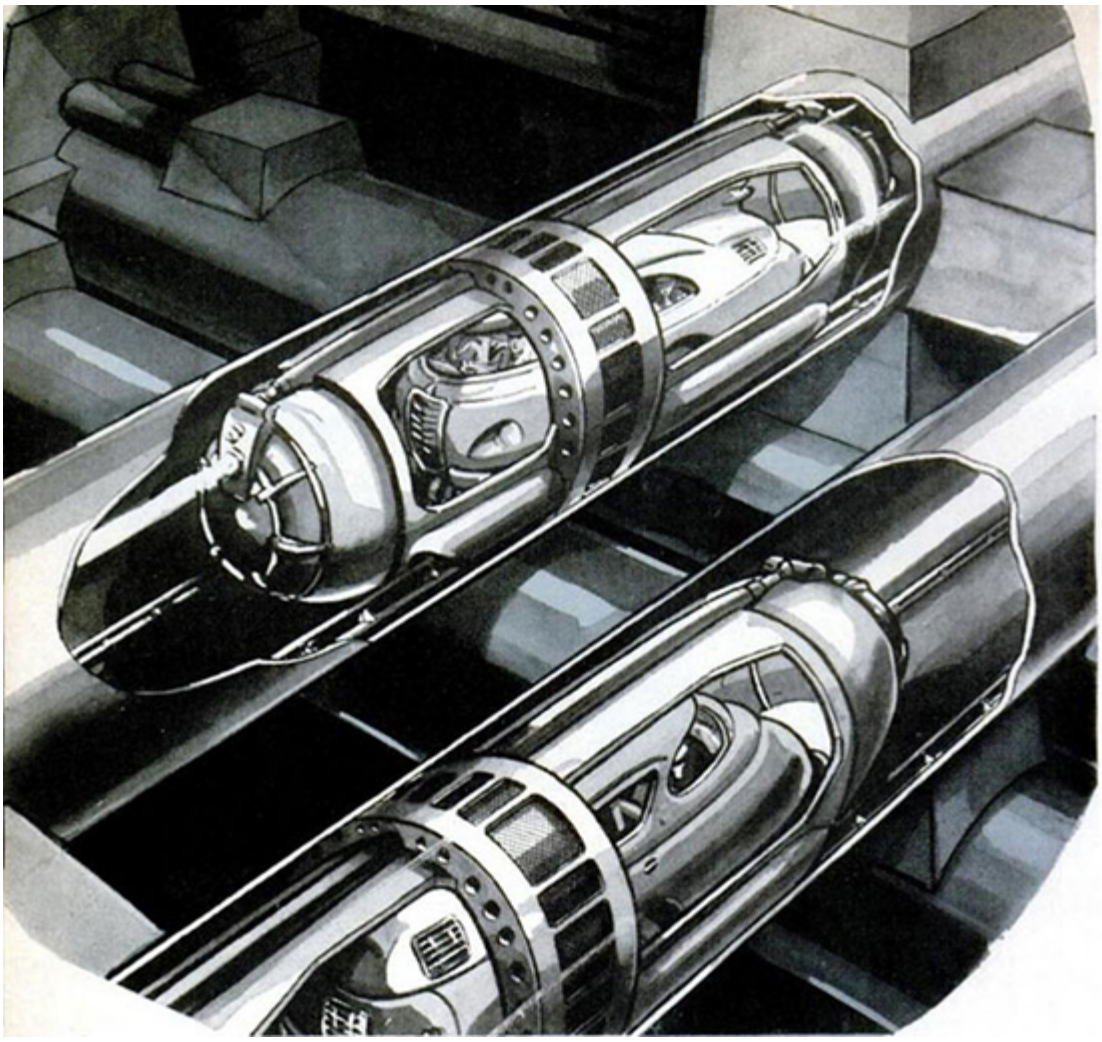
Constructing the tube network will be the biggest infrastructure project the earth has ever seen, with a projected 50-year build-out employing in excess of 100 million people along the way. But in addition to these impressive projections, there's far more at stake than just jobs and superfast transportation. Here's why.

Transportation Trends

According to Richard Florida, author of the best seller "Rise of the Creative Class," average transportation speed in the U.S. in 1850 was 4 mph. As more cars and trains came into use, by 1900 speeds had doubled to 8 mph. Driven by the Henry Ford car era and an emerging airline industry, by 1950 the pace of travel tripled to 24 mph. With airline travel becoming far more common, by 2000 the average was boosted all the way to 75 mph.

Following this trend line, the logical next iteration of travel will boost averages to 225 mph or more.

So what is the breakthrough in transportation that will move us to a whole new level of speed and efficiency? Many are beginning to think tube transportation is the logical next step.



Published in Popular Mechanics in 1957, this image came with the caption, “Honeywell engineer predicts that by 2000 cars will zip through a network of crash proof pneumatic tubes.”

Early History – The Vactrain

For nearly a century, this form of future travel was being referred to as the “vactrain concept.”

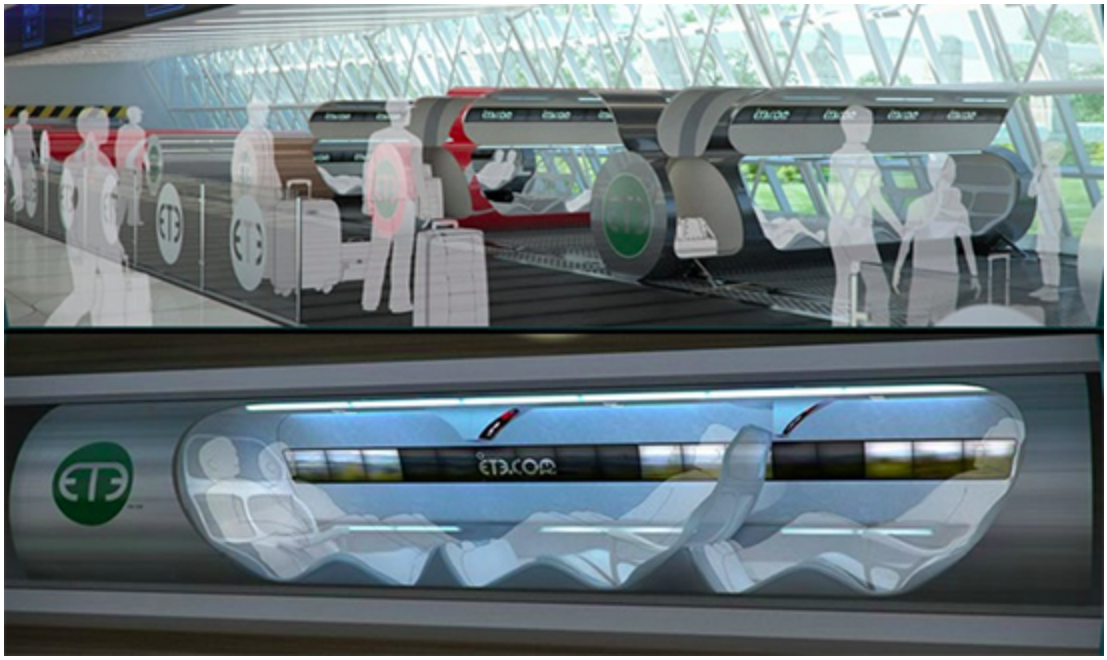
Russian professor Boris Weinberg proposed a “vactrain” concept in 1914 in his book Motion without Friction. He also built an earlier model at Tomsk University in 1909.

The vactrain concept was also being studied in 1910 by American aerospace pioneer, Robert Goddard, who created a detailed prototype with a university student. His train was designed to travel from Boston to New York in 12 minutes, averaging 1,000 mph. The train plans were found only after Goddard’s death in 1945 and shortly thereafter his wife filed for the patents.

Vactrains later made headlines during the 1970s when a leading advocate, Robert M. Salter of RAND, published a series of elaborate engineering articles in 1972 and again in 1978.

Vactrains also appeared in science fiction novels, including Arthur C. Clarke’s *Rescue Party* (1946), Ray Bradbury’s

Fahrenheit 451 (1950), and Robert A. Heinlein's *Friday* (1982).



ET3 vacuum tube transportation concept

Getting ET3 Started

Daryl Oster's epiphany moment happened back in the 1980s in a mechanical engineering class in college when he was calculating the drag coefficient on various shaped objects in a wind tunnel and made a mistake with air-density. On a lark he dropped the air-density to zero and it suddenly occurred to him how beneficial it would be to travel in a vacuum.

Over the following decades, designing ET3's vacuum tunnels and maglev tracks became an obsession for Oster, as he oriented his work and research around the massive benefits of frictionless travel, forming the original company in 1997.

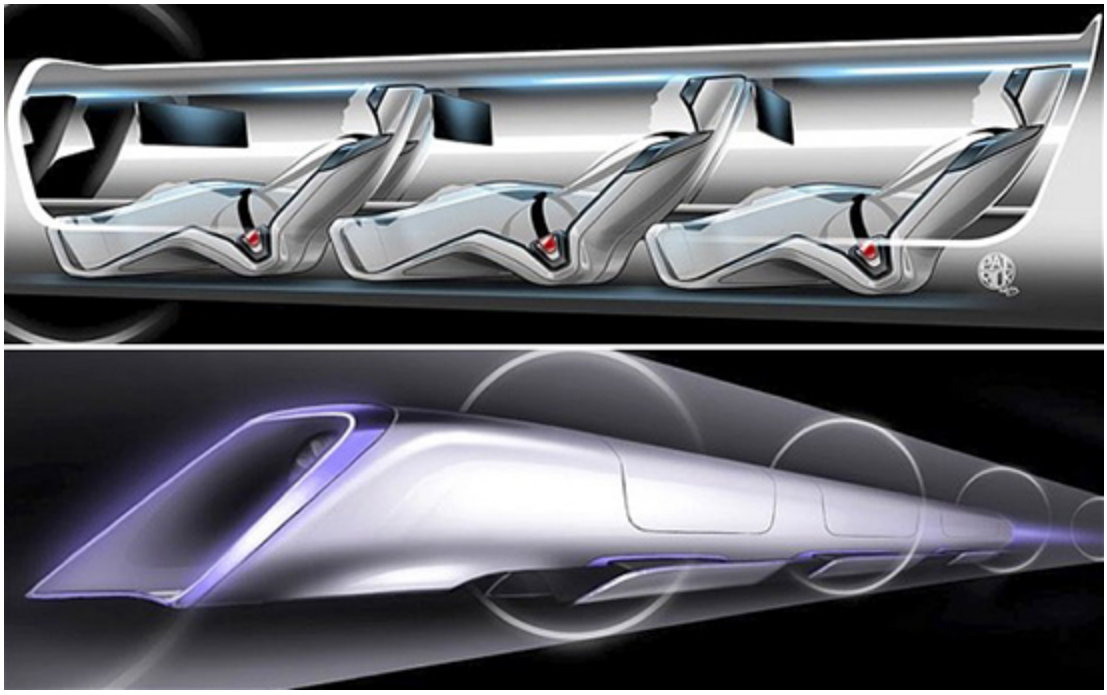
In 2012 Oster formed the ET3 Global Alliance to serve as a licensing consortium to create an open opportunity for key companies and individuals around the world to participate. The Alliance allows for easy pooling of technology and intellectual property along with equally simple licensing of the technology.

There are three differentiating features in the ET3 design. First it's built around a narrow tube diameter to reduce weight and maximize vacuum efficiency. Narrower tubes, only 5' in diameter, mean less vacuum pumping, lighter pylons and bridge supports for elevated segments and less drilling when going underground or through mountain ranges.

Second, Oster's capsules are relatively small, designed around the dimensions of a midsize car, 4'3" high and 16'2" long. Small capsule sizes mean lower costs for things like the yttrium barium copper oxide ceramics on board to maintain superconductivity, and less cost for life-support and entertainment systems. Each capsule will have room for up to six seats for passengers or three pallets for cargo. The maximum weight including passengers, baggage, and cargo: 1,212 pounds. Minimal sized capsules means less stresses and lower costs throughout the entire system, translating into massive cost savings, operating at one-tenth that of high speed rail or a quarter of the cost of cars

on a freeway.

The third differentiator is the use of high-temperature superconducting maglev, which ET3 licensee Yaoping Zhang pioneered at China's Southwest Jiaotong University. The technology uses liquid nitrogen rather than liquid helium as a coolant, which lets the system run somewhere between 63 and 77 Kelvin – minus-321 to minus-346 Fahrenheit – the zone in which nitrogen neither boils nor freezes solid. Traditional maglev runs on helium which is much more expensive. The capsules will have the superconductor material onboard.



Two of the Hyperloop drawing released by Elon Musk

Hyperloop's Background

Elon Musk first mentioned that he was thinking about a concept for a "fifth mode of transport", calling it the Hyperloop, in July 2012 at a PandoDaily event in Santa Monica, California. He described several characteristics of what he wanted in a hypothetical high-speed transportation system: immunity to weather, cars that never experience crashes, an average speed twice that of a typical jet aircraft, low power requirements, and the ability to store energy for 24-hours of operation. He estimated at the time that the cost of the Castro Valley-Sylmar Hyperloop would be about US$6 billion.

Musk has likened the hyperloop to a "cross between a Concorde and a railgun and an air hockey table," while noting that it has no need for rails. He also noted it could work either above or below ground.

From late-2012 until August 2013, an informal group of engineers at both Tesla and SpaceX worked on the conceptual foundation and modeling of Hyperloop, allocating some full-time effort to it toward the end.

The tubes would maintain a vacuum-pressure equivalent to an altitude of 150,000 feet. This is very thin air, but still 1,000 times denser than ET3's proposed vacuum, and therefore easier to manage leakage and entry and exit of capsules through airlocks. But even that tiny amount of air is enough to dramatically increase demands on the capsules, which include a vacuum engine powered by a 436-hoursepower motor.

A high-level alpha design for the system was published on August 12, 2013, in a whitepaper posted to the Tesla and SpaceX blogs. Musk also invited feedback as an open source design project to "see if people could find ways to improve it."

The following day he announced a plan to construct a demonstration of the concept.

The Meeting Between Oster and Musk

On Sept 18, 2013, Daryl Oster and his team from ET3 met with Elon Musk and his engineers at the Space X headquarters in Hawthorne, California.

After a brief tour of Musk's rocket facility the two got into a detailed discussion of evacuated-tube transport systems, a topic both feel is worth fighting for. Through their discussions, ideas began to converge, and Oster told Musk he was working on securing a site for a three-mile, $30 million ET3 prototype and hoped to break ground before the end of 2013.

Musk wished him luck and offered one piece of advice: "Just build the three miles. And you'd better be careful — don't hurt anyone."

He also indicated he may be interested in investing in ET3, but he didn't want to be the lead investor.

Proposed global trunk line for ET3

The World's Largest Infrastructure Project

Assuming the pilot project goes well and no one gets hurt along the way, it's easy to envision a mad scramble between countries vying to be next. Once a technology sets a new standard, no one wants to get left out.

Like any radically new technology, it starts with a level playing field.

The pilot project will lead to the first city-to-city project, and once successful, a rush-to-be-next will ensue. A global consortium will be assembled to map out plans for international trunk lines, and individual countries will begin thinking through feeder line strategies to connect to the cross-continent central system.

Within a few years the vision will morph into a tangible reality, and like road-builders in the past, schools and training systems will crop up around the world, and construction will begin.

Even before the main trunk lines are complete, an entire network of feeder lines will begin to crop up both for bragging rights and to help countries gain a better grasp on this new form of transportation.

It's important to understand that even with the most optimistic scenarios, it will still take decades for the complete build out.

All told, this new transportation system will cost well over $1 trillion to construct, creating over 100 million jobs over the next 50 years.

Vacuum tubes proposed to route traffic around the world

The Value of a Super Connected Society

Besides cutting pollution and dramatically lowering our carbon footprint, faster and cheaper transportation will lead to a far more connected world. The number of people crossing country boarders each year will grow from millions to billions, and conducting business on seven continents simultaneously will become as routine as our cross-cultural thinking.

A super-connected society is also a dependent society. More than ever people will learn to need and respect each other. That's not to say there won't be outliers who want to destroy much of what is being built, but the majority of people will shift their thinking from micro-neighborhoods to macro-neighborhood.

At the same time, unique talent will become more discoverable. Artisans and craftsmen will all be able to carve out their own niche. Serendipity will grow exceedingly long arms and once-in-a-lifetime meetings and events will begin happening with far greater frequency.

Along with increasing levels of both physical and digital awareness, the IQ of the entire planet will climb significantly.

Final Thoughts

Back in 1972, RAND's Robert Salter wrote, "We no longer can afford to continue to pollute our skies with heat, chemicals and noise, nor to carve up our wilderness areas and arable land for new surface routes. Nor can we continue our extravagant waste of limited fossil fuels."

Today, the U.S. population is 50% larger; U.S. airline passenger miles have leapt by a factor of 20; we drive, collectively, 250% more miles in more than twice as many vehicles; and our atmosphere is laden with 21% more carbon dioxide.

Vacuum tube transport is not just a great idea; it's becoming a moral imperative. Ships and planes are polluting our oceans and skies faster than nature can clean it up. This is a solution that will not only solve all those problems; it will create over 100 million jobs along the way. And, most importantly, it will pay for itself.

If it were on this year's ballot, I would vote yes.

By Futurist Thomas Frey

Author of *"Communicating with the Future"* – the book that changes everything

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1. **Gavin** Says:
   October 30th, 2013 at 4:16 pm

   Sorry Mr Frey I would need a lot of convincing on this one. I personally think the trillions of dollars could be better spent on new battery tech for vehicles like cars and if feasible planes or for a much cleaner fuel we can breed with bacteria and such.

   I like the idea of bespoke door to door autonomous vehicles too much.

   Now for further distant travel around the Earth I fancy those suborbital spaceplanes, I had an idea I'm not sure if feasible for an earth spacecraft to be fired from a vertical railgun on a short track (several thousand meters) into space. This would cut travel times down several fold while maintaining fuel efficiency. A anti G-force countermeasure technology would probably be needed due to the acceleration over a short track.

   Maybe a rotational passenger cabin could keep the passengers in a horizontal position while taking off and flying for comfort. Am I a fantasist Mr Frey?

2. **FuturistSpeaker** Says:
   October 31st, 2013 at 11:11 pm

   Gavin,

Thanks for weighing in on this. But I don't see this as an either/or situation. Driverless cars will still happen for person-to-person point-to-point travel, but vacuum tube transport will not only open the doors on mass transit, but will also be an enabling technology for space tourism and space travel. Batteries will also develop independent of this, but the Hyperloop team (Tesla) will likely be heavily focused on better battery tech.

Thomas Frey

3. **Gavin** Says:
November 1st, 2013 at 3:28 pm

After having thought about it a bit longer Mr Frey, my main concerns are resource allocation and the technology level of today being adequate. With today's resources being better spent on other things today.

If it makes economic sense to start investment today, whats the saying? Never put off until tomorrow what you can do today.

I actually like the idea of for example, a family could live in Australia and they want to go shopping in New York for example for the day. Those RailPods will have to travel at some speed to do this.

First they get into their Google Car which drives them to the nearest HyperRail hub. The car drives straight into the RailPod which zooms off in less than a minute. 5000mph to New York = 2 hours

Once in New York the Google car drives off the RailPod to drive them to their favorite restaurant.

My biggest bugbear with trains is the waiting between trains for your destination, for me its about an hour. Also the trains don't run 24/7. To make the RailPod service more consumer/commuter friendly the HyperRail tube may have to have many more RailPods than could be considered energy efficient.

This is why I think it may be best to start such a large project when energy use is less of a concern, when there is abundant fusion/large scale solar. Also the abundance of automation (humanoid robots) in around 30 years could make short work of such a massive project, taking it down to 10 years till completion.

4. **FuturistSpeaker** Says:
November 2nd, 2013 at 12:30 pm

Gavin,

Keep in mind that both ET3 and Hyperloop will be business entities that create new wealth. They'll both create their own economy. It's not like they'll be subtracting money from other causes. Instead, it's just the opposite.

Since both systems are run on some form of electricity, the energy part of the equation will evolve along with the rest of the power generation industry. In fact, because of higher efficiencies, they'll cause lower power demands, less pollution, and far less unemployment.

We really don't have the luxury of waiting while all of our natural resources are squandered away.

Thomas Frey

5. **James Robertson** Says:
November 2nd, 2013 at 9:22 pm

You know all the right of way acquisition issues that rail has? Guess what? this runs into the same problem. What you people fail to grapple with is that technology is not the issue here – regulatpry hurdles are. So long as you keep electing "green" politicians who pile rule upon rule, you'll keep being baffled as to why projects

like this can’t get off the ground.